



## Advanced Biofuels Process Demonstration Unit - ABPDU



Lawrence Berkeley  
National Laboratory



**ABPDU**

Advanced Biofuels  
Process Demonstration Unit

The ABPDU is a state-of-the-art facility at Lawrence Berkeley National Laboratory for testing and developing emergent biofuels technologies.

This 15,000-square-foot facility is available to Bioenergy Research Centers, DOE-supported researchers, academic institutions, nonprofit research organizations, and companies involved in biofuels R&D.

The ABPDU was built and is operated with funds from the Office of Biomass Program within the U.S. Department of Energy's (DOE) Office of Energy Efficiency and Renewable Energy and funded by the American Recovery and Reinvestment Act.

**Major capabilities of the ABPDU are:**

- Thermochemical pretreatment
- Enzymatic biomass saccharification
- Biofuel fermentation
- Enzyme fermentation
- Downstream processing
- Analytical technologies





## Facility Equipment and Capabilities

The ABPDU provides its collaborators with the ability to produce demonstration quantities of biofuels from biomass such as grasses, wood, and agricultural residues.

The facility is fully equipped for pretreatment, fermentation, and downstream processing, along with rigorous analytical characterization capabilities at each step.

For every stage in biofuel production, the facility can provide material and energy balance data to help develop parameters for expansion from pilot- to commercial-scale production.

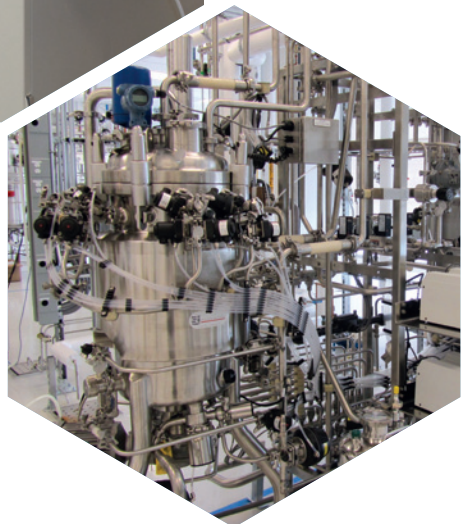
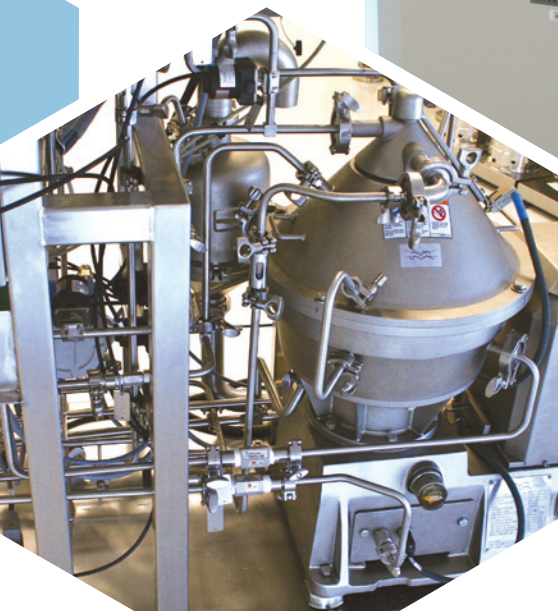
ABPDU is equipped with thermochemical pretreatment reactors of up to 100 liters, fermenters of up to 300 liters, and enzymatic saccharification reactors of up to 50 liters.

### Pretreatment

The ABPDU has several reactors capable of performing the following pretreatment processes:

- Dilute acid
- Hydrothermolysis
- Alkali
- Ionic liquid

Each reactor is equipped with data logging and collection equipment. The operating temperature range is from 25 – 200°C. The 10 liter reactors can operate at elevated pressures (1,800 psig max). A 100 L reactor (180°C, 150 psig max, Hastelloy C22) will be online in December of 2012. Recovery of biomass fractions after pretreatment can be accomplished using any combination of mixer-settler tanks, continuous centrifuges, and decanters with the appropriate solvents. Pilot scale liquid-liquid extraction is also available.



## Saccharification

Four 2-liter and one 50-liter stirred enzymatic saccharification reactors, with temperature control up to 100°C, are available for study of enzymatic biomass hydrolysis from a variety of enzyme sources. The ABPDU has commercial enzyme cocktails to provide a performance baseline for any process flow.

## Fermentation

The unit has capacity to grow bacteria, fungi, or yeast engineered to produce either advanced biofuels or enzymes for deconstruction of plant biomass.

ABPDU bioreactors are capable of both anaerobic and aerobic operation under aseptic conditions. The facility features a bank of 3-liter, 20-liter, 50-liter, and 300-liter bioreactors to test different production conditions for demonstration and scale-up of processes for advanced biofuels and enzymes. These reactors are equipped with advanced control systems for pH, temperature, dissolved oxygen, and other process conditions. Advanced monitoring capabilities include in-process sampling and exit gas mass spectroscopy.

The facility is equipped to purify enzymes for various applications. It offers:

- A continuous high-throughput centrifuge for cell harvesting
- Cell lysis equipment
- Pilot scale ultrafiltration
- Chromatography system for enzyme separation and purification
- Protein characterization and analysis equipment

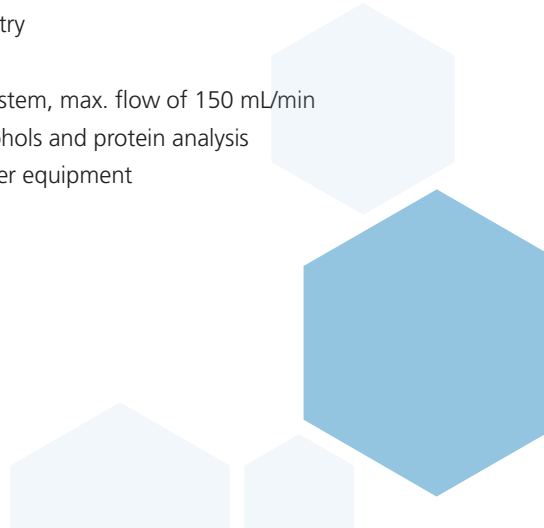
## Biofuels separations

A key advantage of advanced biofuels is their separation properties due to their increased hydrophobicity relative to ethanol. Most of the advanced biofuels have very low solubility in the fermentation broth. These fuels will phase-separate from the aqueous growth medium without expensive, energy-intensive distillation. To explore many different separation methods to purify these advanced biofuels, the facility is equipped with:

- Flow-through centrifuges
- A Karr column for liquid-liquid extraction
- Mixer-settlers

## Analytical chemistry and biology

The ABPDU offers a wide range of analytical capabilities, including:

- GC-FID
  - UV-Vis and NIR spectroscopy
  - Precision bomb calorimetry for solids and liquids
  - State-of-the-art rotational rheometry
  - HPAEC for sugar analysis
  - ÄKTA avant protein purification system, max. flow of 150 mL/min
  - HPLC for sugar, organic acids, alcohols and protein analysis
  - Optical microscopy and plate reader equipment
  - Compositional analysis
- 

## ABPDU Project Stages

- **Initial contact.** Prospective collaborator provides information and a description of desired process flows on the ABPDU Project Proposal form, available online at [www.abpdu.lbl.gov](http://www.abpdu.lbl.gov).
- **Consultation.** With assistance from ABPDU staff, develop a detailed workflow.
- **Scheduling.** Set timelines for processing; specify raw materials and desired analytical information.
- **Review.** ABPDU staff and collaborators review the agreed upon process and all safety issues. Work for other agreements and nondisclosure agreements are executed as needed.
- **Implementation.** ABPDU staff manages and completes the processing.
- **Data collection and reporting.** Real-time process monitoring takes place at on-site workstations. Staff provides a report to the collaborator.

We invite you to contact ABPDU scientists and engineers to discuss your biofuel process demonstration, development, and scale-up needs. You are welcome to visit the facility and meet with our staff.

## Submitting a Proposal

To use the ABPDU, you must first submit a brief Project Proposal describing your plan and how use of the facility will advance your technology. Proposals will be reviewed and prioritized by the ABPDU Executive Committee. Upon project approval, facility management will work with you and your scientific team to develop user protocols.

Along with an ABPDU Project Proposal form, please include the following in your proposal:

- Description of technology and project
- Details of facility modifications (if required)
- List of raw materials and availability

Forward the proposal to [ABPDU@lbl.gov](mailto:ABPDU@lbl.gov).

Once a proposal receives acceptance from the ABPDU Executive Committee, ABPDU staff will coordinate with the collaborator and complete the project, operating 24/7 as needed.

---

**Contact** Program Manager, ABPDU

**Site Address** 5885 Hollis Street, 3rd Floor, Emeryville, CA 94608

**Mailing Address** One Cyclotron Road MS 978-3200, Berkeley, CA 94720

**Telephone** 510-486-4339 or 510-486-6961

---

For more information, contact [ABPDU@lbl.gov](mailto:ABPDU@lbl.gov) or visit [www.abpdu.lbl.gov](http://www.abpdu.lbl.gov)

---

